

Nanoparticle removal restores turbine oil performance

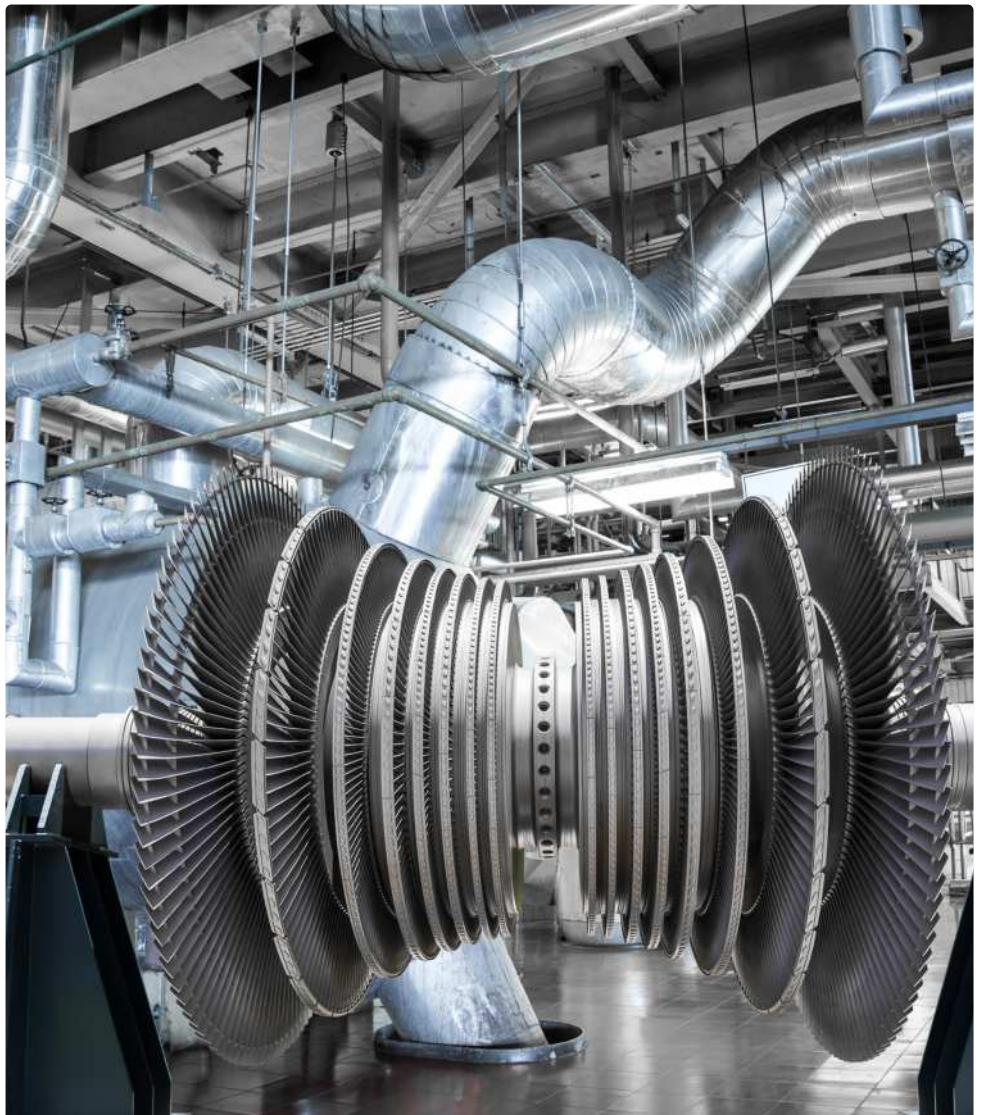
How RecondOil's Double Separation Technology (DST) removes nanoparticles and extends lubricant life.

The unseen mechanisms behind turbine oil degradation

Modern turbines operate under increasingly harsh conditions – high temperatures, shear stress, air ingress, moisture, and particulate contamination – which all accelerate oxidation and degradation of turbine oils. Over time, these factors compromise reliability, increase maintenance costs and shorten lubricant service life.

Building on our whitepaper demonstrating the role of nanoparticles in **lubricant degradation**, this study explores how RecondOil's Double Separation Technology (DST) restores turbine oil performance by removing contaminants down to the nanoscale.

The results show that DST not only improves cleanliness but also restores vital functional properties – extending oil life, improving turbine reliability, and supporting a circular use of oil.





Oil degradation under turbine conditions

Turbine oils face complex degradation mechanisms. Oxidation, water ingress, and particulate contamination interact to break down additives, increase acid formation, and generate sludge and varnish.

Among these stressors, nano contaminants – ultra-fine wear and degradation particles invisible to conventional filtration – are an overlooked but crucial factor.

Because of their high surface energy, nanoparticles accelerate oxidation and catalyse additive depletion.

Removing them requires more than standard filtration. DST continuously captures these reactive contaminants, helping to stabilise the oil and prevent degradation before it escalates.

40%

Oil can account for 5% of your maintenance budget, but affects 40% of maintenance costs.

Study design:

New, used, and DST-treated turbine oil

A mineral turbine oil (ISO VG 68) was analysed under three conditions:

- New oil – baseline performance.
- Used oil – after service in turbine operation.
- DST-treated oil – used oil regenerated with RecondOil's DST.

Visual comparison (Figure 1) shows that while used oil darkened to a red-brown tone from oxidation and additive depletion, the DST-treated oil recovered much of its clarity, confirming substantial contaminant removal.

Although colour alone is not a reliable indicator of oil health, this visual improvement highlights the significant restoration achieved through DST.

Figure 1: Oil sample colours (New, used, DST-treated)



80%




Nanoparticles, which make up 80% of the contaminated surface area in oil and typically bypass conventional filters, pose significant harm.

Cleaner than new:

Contamination control results

Three complementary methods – ISO 4406 particle count, Membrane Patch Colourimetry (MPC), and gravimetric contamination – quantified the oil's cleanliness.

DST reduced contamination below even the level of the new oil. MPC results confirmed that varnish potential dropped from 'monitor' to 'normal' levels, while gravimetric tests showed a near tenfold reduction in solid residues. Together, these indicate that DST effectively removes both particulate and degradation byproducts, including those below the 0.45 µm range that conventional filters miss.

Analysis	Unit	Method	New	Used	DST
Particle count		ISO 4406	17/14/9	22/20/17	16/15/12
MPC (Varnish potential) (Size>0.45 µm)	ΔE (dB)	ASTM D7843	 2.6	 25.7	 1.1
Gravimetric contamination (0.8 µm)	mg / 100 ml	ISO 4405	1.4	3.4	1.4

Recovering key properties:

Lubricant performance restoration

DST's impact extended beyond cleanliness. It also restored key physico-chemical properties essential for turbine performance and reliability.

After DST treatment, water content and TAN returned to near-new levels, demonstrating removal of moisture and acidic oxidation products. Oxidation stability improved by nearly 50% compared with used oil, confirming that DST effectively slows degradation processes. Air release and demulsibility also improved, reducing risks of foaming, cavitation and corrosion.

While some colour change and minor additive depletion remain irreversible, these results clearly show that DST restores the oil's functional integrity and stability – keeping it in service far beyond conventional replacement intervals.

Analysis	Unit	Method	New	Used	DST
Water content	ppm	ASTM D6304	25	47	24
TAN	mg KOH / g	ASTM D664	0.02	0.05	0.02
Oxidation stability (min)	RPVOT	ASTM D2272	>1000	523	775
Demulsibility (oil/ water/emulsion)	ml / min	ASTM D1401	40/38/2 10	40/37/3 30	40/37/3 20
Air release	min	ASTM D3427	3.6	6.4	5.3



Findings:

Nanoparticle removal restores turbine oil performance

The study confirms that nanoparticles play a central role in turbine oil degradation – and that removing them is key to restoring lubricant health.

DST-treated turbine oils demonstrated significant improvements across multiple dimensions:

- Cleanliness beyond new oil levels.
- Restored oxidation stability and acid balance.
- Improved air release and demulsibility.
- Extended service life and reliability.






Implications for industry:

From linear to circular use of oil

For turbine operators, these findings demonstrate that RecondOil's DST is more than a filtration solution – it's an enabler of circular oil use.

DST technology can:

-  Extend oil service intervals
-  Improved turbine reliability and uptime
-  Reduced environmental impact

By continuously removing the smallest degradation byproducts, DST helps maintain oil in a 'like-new' condition – moving lubricant management from a consumption model to a circular one.

Conclusion:

A sustainable breakthrough for turbine maintenance

Nanoparticles are an often-overlooked factor in turbine oil degradation. This study demonstrates that DST treatment can significantly restore turbine oil performance – reducing oxidation, stabilising additives, and extending service life.

By keeping oil ultra-clean and functionally stable, DST enables turbine operators to treat oil not as a consumable, but as a sustainable asset – improving efficiency, reliability and environmental performance.

93%

DST reduced nano contaminants by 93%

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PUB LS/S7 20235 EN · November 2025

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